Solid State Sciences
Volume 71, September 2017, Pages 75-86

Morphology dependent UV photoresponse of Sn-doped ZnO microstructures

V. Postica, M. Hoppe, J. Gröttrup, P. Hayes, V. Röbisch, D. Smazna, R. Adelung, B. Viana, P. Aschehoug, T. Pauporté, O. Lupan,

https://doi.org/10.1016/j.solidstatesciences.2017.07.008

Abstract

In this work, the UV sensing properties of Sn-doped and/or alloyed zinc oxide (ZnO) microstructures with different morphologies were investigated in order to elaborate the high performance UV photodetectors. We have compared two types of morphologies, i.e. Sn-doped ZnO films (ZnO:Sn) and ZnO microtetrapod (T) networks alloyed- and doped-with Sn (ZnO-T:Sn). The UV response (IUV/Idark) of ZnO:Sn is about 103 and 102 for 0.1 and 0.4 at% Sn, respectively. The three-dimensional highly porous ZnO-T:Sn networks demonstrated higher UV response (by two orders of magnitude) and much faster recovery for detection of UV light, which were attributed to the domination of fast processes such as modulation of potential barriers formed at the interface of the tetrapod arms, which are less dependent on adsorbed species. Thus, the UV response for devices with a distance between the pads (interelectrode distance) of about 60, 400, 800 and 1500 μm is 1.7 × 105, 2.4 × 104, 6.7 × 103 and 925, respectively. All samples demonstrated a sharp increase in photocurrent under illumination with UV light, as well as a fast recovery to the initial electrical baseline. Also, the influence of relative humidity on the rapidity of photodetectors based on ZnO:Sn films and ZnO-T:Sn networks was investigated, confirming a low impact on the rapidity of ZnO-T:Sn networks, with good repeatability and stable electrical baseline, which is very important for effective applications.